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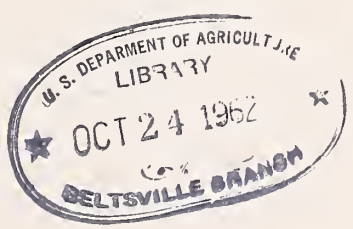
# PROGRESS REPORT ON HARVESTING VIRGINIA TYPE PEANUTS

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Without the cooperation of the above personnel, industrial groups, and peanut growers, this work could not have been conducted.

# PROGRESS REPORT ON HARVESTING VIRGINIA TYPE PEANUTS [1/]

By
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## INTRODUCTION

High labor costs and a shortage of farm labor to stack and pick peanuts from the stack pole have necessitated the study of more economical methods of peanut harvesting. The rising labor costs and shortage of labor due to migration away from the farms has been felt by peanut producers throughout the belt which extends from Texas and Oklahoma through Alabama, and in Florida, Georgia, North Carolina, and Virginia. Many man-hours of labor are required to hand stack the peanuts and pick them with stationary pickers where the stack pole method of peanut harvesting is used.

About 1945, personnel of the colleges and experiment stations of several States and the U. S. Department of Agriculture began investigating other methods of peanut harvesting, such as the use of combines to pick peanuts directly from the windrows and drying peanuts by artificial means. References on work to date are listed at the end of this report.

In Texas and Oklahoma 85 to 95 percent of the crop is combined; 50 to 60 percent of the Georgia crop is combined. A few combines (10 to 15) were sold in North Carolina in 1956; the number sold is expected to double in 1957. There is no available record of any combine having been sold in Virginia before 1957.

## PRESENT METHODS OF PEANUT HARVESTING IN VIRGINIA

In Virginia the large-type bunch and the large-type runner peanut varieties are grown. The peanuts are planted from May 1 to May 15, dug from September 25 to October 25, and picked in November and December. Two-row tractor equipment is used. The rows are spaced approximately 28 to 36 inches apart. Yields vary from 1,500 to 3,500 pounds per acre with many growers averaging as much as 2,500 to 3,000 pounds per acre.

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[1/] Cooperative investigations of the Agricultural Engineering Research Division, Agricultural Research Service, USDA, and the Virginia Experiment Station.

[2/] Located at the Virginia Tidewater Research Station, Holland, Va.

Figure 1. Digging peanuts with a one-row pull-type peanut digger.

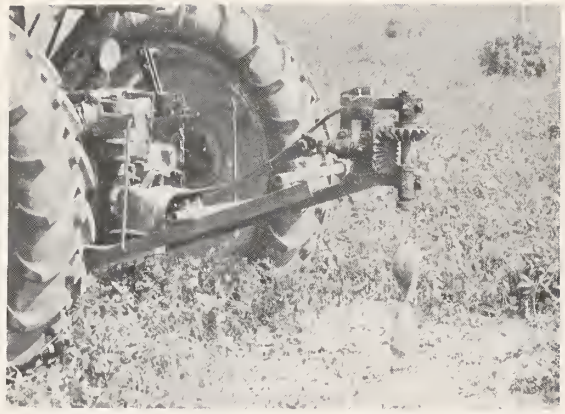

Figure 2. Digging stack pole holes with tractor operated auger.

Figure 3. Setting and firming soil around the stack pole.

Figure 4. Shaking and bunching peanuts in small cocks prior to stacking.

Figure 5. Hand stacking peanuts.

Figure 6. Stacked peanuts curing and drying on stack poles.

Figure 7. Hauling stack pole peanuts to the stationary picker.

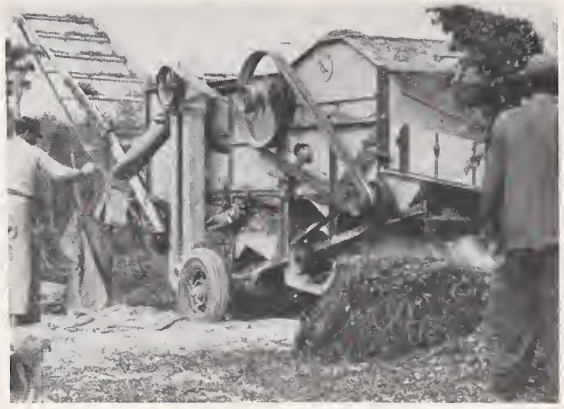

Figure 8. Removing and separating peanuts from the vines with a stationary picker or thresher.

Today peanuts in Virginia are dug with commercial-production one- or two-row peanut diggers designed with cutting blades and lifting fingers or rods attached to the rear edge of the blade. The blade cuts the tap roots, and the vines are further lifted and shaken (1) by agitating fingers or (2) by being carried over star-shaped kicker wheels. After digging they are shaken by hand or side raked, stacked on poles, and picked with stationary pickers. Figures 1 through 8 show the conventional harvesting methods in Virginia.

Windrow Harvesting Before 1952: Work on peanut drying and curing in Virginia before 1952 was done by Baker, Cannon, and Stanley (2). Their results were published in June 1952. A quotation from their report relative to the machinery aspects of digging and combining is as follows:

> "As the digger travels down the row, the blade raises the vines, nuts, and dirt up over the shaking device, where a portion of dirt is removed and then the mass of vines, nuts, and remaining dirt fall to the ground. The large peanuts and soil types in the area of this test made digging difficult. In order to remove a high percentage of the nuts from the ground, it was necessary to use hand labor and pitchfork to shake the dirt from the nuts after they had been dug with the machine. After the nuts were removed from the ground and the dirt shaken from them, they were allowed to wilt in the field until a moisture content of about 35 percent wet basis was reached. Then a cylinder-type semicombine and a conventional stationary carding-type picker were used to remove the nuts from the vines. Tests have shown that the carding-type pickers are more effective for picking nuts from green vines and that they damaged fewer peanuts than cylinder-type pickers. The semicombine was towed through the field so that the nuts and vines could be forked into it. A peanut combine that will do a satisfactory job of removing runner and jumbo peanuts from the windrow under Virginia conditions has not been developed."

Windrow Harvesting After 1952: In the fall of 1952 the Divisions of Farm Machinery and Farm Buildings and Rural Housing of the former Bureau of Plant Industry, Soils, and Agricultural Engineering, U. S. Department of Agriculture, set up projects to study the windrow method of harvesting for the Virginia area. The newly established Agricultural Research Service of the Department has continued the projects since 1953. The Virginia Agricultural Experiment Station has cooperated in this program, conducted at the Tidewater Research Station, Holland, Va. Peanut diggers and combines were field tested and modified for the purpose of adapting the equipment to the windrow method of harvesting.

A time study was made by the project personnel in 1954 to determine the labor requirements for some of the various operations in connection

with the stack-pole and combine methods of peanut harvesting. Results were as follows:

Stack-Pole Method:

| | | |
|---|---|---|
| 1. | Digging with one-row diggers | 1.50 man-hours/acre |
| 2. | Setting the stack poles | 4.95 " " " |
| 3. | Stacking peanuts and vines by hand | 17.1 " " " |
| 4. | Picking with stationary picker | 14.8 " " " |
| | Total man-hours required | 38.35 " " " |

Combine Method:

| | | |
|---|---|---|
| 1. | Digging with two-row digger-shaker-windrower | 1.0 man-hours/acre |
| 2. | Shaking and windrowing after digging but before combining | 1.75 " " " |
| 3. | Combining the windrow | 1.75 " " " |
| | Total man-hours required | 4.50 " " " |

Although the windrow combine method of peanut harvesting required approximately 4 to 6 man-hours per acre, additional cost and labor must be added for artificially curing and drying the crop after combining.

An investigation of the windrow method of harvesting involved the establishment of the type and number of field operations needed and the equipment requirements to satisfactorily perform these operations. The procedures and the results of the study included two main phases of work; namely, (1) preparation of the peanut windrow and (2) combining the peanuts from the windrow.

## PREPARATION OF THE WINDROW BEFORE COMBINING

Several different types of experimental and production model peanut diggers were field tested in search of a satisfactory digger for use with the combine program. The operating principles of the various diggers tested are briefly described.

Two-row Digger with Agitating Fingers: Figure 9 shows a two-row production-type peanut digger which has two long cutting blades for cutting

Figure 9. Two-row peanut digger with agitating fingers.

Figure 10. Two-row digger with rotating rollers.

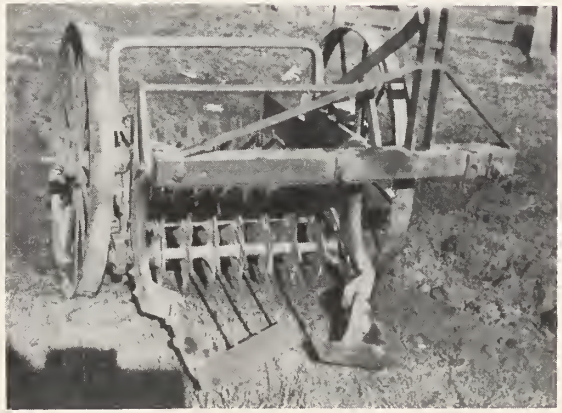

Figure 11. One-row pull-type peanut digger with two-piece blade and star-shaped agitating wheels.

Figure 12. Power-driven one-row digger with three-point hitch.

the roots and loosening the soil. Lifting fingers pivoted at the front are located behind the blades. The rear sections of the fingers operate up and down by means of a crank and connecting bar. Power for activating the fingers is transmitted from the PTO shaft of the tractor through a right-angle gear case to the crank and connecting bar. This digger plows up the peanuts and gradually works the roots and nuts upward out of the ground. But it does not completely free the vines from the soil, nor does it form a satisfactory windrow for the planned combining operations.

Two-row Digger with Conical Rollers: The equipment shown in figure 10 is a 2-row unit with 3-point hitch. It is especially designed to dig the Spanish and runner-type peanuts in other areas. Two cutting blades cut the taproot and loosen the soil. Round steel rods bridge the space between the blades and the conical-shaped rotating rollers. The rollers are powered by V-belts from the tractor wheels. Peanut vines are lifted over and discharged behind the rollers. When this digger was given limited tests under Virginia conditions of rank vine growth, it became congested and wrapped, and the mechanism ceased to operate. Peanuts were pulled off the vines and too much dirt remained in the plants. This digger did not form a satisfactory windrow for combining.

One-row Digger, Ground-driven Pull-type: Figure 11 shows a popular digger in Virginia. This digger is of the one-row type. It is pulled behind the tractor, and ground driven. Lifting rods one-half inch in diameter inclined rearward are attached to the cutting blades. Behind the lifting rods are four rows of agitator wheel-and-shaft assemblies, which rotate to shake the soil from the roots of the plant and to move the plants through the digger. Extra wheel assemblies may be added if desired to shake out more soil under adverse conditions. The peanuts and vines are raised 14 to 18 inches before they are dropped back on the ground.

One-row Integral Digger, Power-driven: Figure 12 shows a recently designed one-row digger which uses the star-wheel-kicker principle. It does not have the large ground-drive wheels; the kicker wheels are driven from the PTO shaft of the tractor. This digger has outperformed the ground-driven type under more severe and adverse conditions of soil and vegetation.

Two-row Digger, Power-driven, with Three-point Hitch: Another recently designed digger using the kicker-wheel principle is capable of digging two standard-width peanut rows (figure 13). It has a three-point hitch and the kicker wheels are driven from the PTO shaft. This digger reduces plow-up time by approximately one half as compared with the one-row digger. Experimental sheet metal fenders were installed to the rear and on each side of the digger in an effort to windrow two 36-inch peanut rows together. The digger did not windrow as desired, and too much soil was left in the vines. With minor changes, this equipment may be converted to dig closely spaced peanut rows in row widths such as 3 rows 15

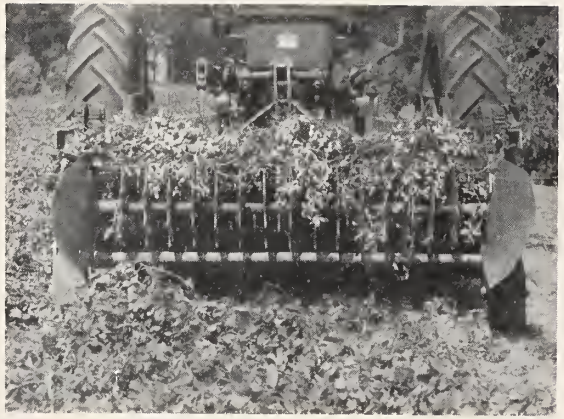

Figure 13. Power-driven two-row digger with three-point hitch.

Figure 14. Experimental two-row peanut digger-shaker-windrower.

Figure 15. Rear field view of experimental digger-shaker-windrower.

Figure 16. Production-type peanut shaker-windrower of the pull type.

inches apart, 3 rows 18 inches apart, or 4 rows 12 inches apart. These row spacings have been satisfactorily dug with this equipment. To convert this digger for close-row use required installation of longer single blades or a one-piece blade.

An Experimental Peanut Digger-Windrower: A survey and test of available diggers did not produce any equipment thought to be satisfactory for coordination with the planned peanut combining operations. In recognition of a need for an efficient peanut digger to aid with the combine harvesting program, brief specifications of such equipment were established as follows:

1. Two-row digger equipped with three-point hitch to be operated from the tractor PTO shaft.

2. Digger that will remove a high percentage of soil from the peanuts.

3. Digger that will partially invert the peanut vines so as to expose the peanuts to the sun and air to aid and hasten the rate of drying of both vines and nuts.

4. Digger that will windrow two peanut rows into one loose, fluffy windrow approximately 30 to 36 inches wide.

An experimental peanut digger having features incorporated in its design to accomplish all of the above requirements was constructed in cooperation with local industry, and field tested. It is shown in figures 14 and 15.

Of the various types of diggers tested, the combination digger-shaker-windrower has more of the features which appear to be desirable in a unit to be used with the windrow method of harvesting.

Results obtained to date from the operation of the digger-shaker-windrower have been gratifying. With the three-point hitch and PTO drive it is easily attached to and detached from the tractors and positive power drives the kickers insuring continuous operation under moderately severe conditions. The kicker wheels and slatted conveyor remove a high percentage of dirt from the vines. The peanut vines are deposited on the ground with two rows placed reasonably close together in a light, fluffy windrow. A high percentage of the vines are turned and some of the nuts are off the ground and thus exposed to sunlight and air. This feature is considered essential and desirable for Virginia conditions. Another desirable characteristic of this digger is that in digging and windrowing, the vines are brought together leaving a clean open area between the windrows for tractor wheels. Space between the windrows is particularly desirable in order to avoid damage to the peanuts by tractor and equipment wheels when the windrow is reshaken and when combining is done.

Although a reasonably good job of soil removal is done with the digger-shaker-windrower, further soil separation, fluffing, and turning of the vines prior to combining are generally considered essential under Virginia conditions. In dry seasons where the crop is dug and windrowed in one operation, satisfactory combining may be possible without re-shaking, but it is doubtful. Under such dry periods, past experience has shown that those vines underneath the windrow and directly in contact with the ground were extremely slow in wilting and drying. In order to obtain uniform drying of the vines and nuts, it was found advisable to shake and fluff the windrow after digging and before combining even under dry weather and soil conditions. If the windrow is rained on, more than one shaking operation generally will be required. Peanut drying in Virginia is retarded because of high rainfall, cool weather, and the short days which come at that time of year.

Commercial Windrowing Machines: Commercial machines are available for shaking and windrowing after digging. Figure 16 shows a pull-type shaker-windrower, and figure 17 shows an experimental shaker-windrower with three-point hitch.

Both of these shaker-windrowers have been field tested and found to perform satisfactorily. Where peanuts are dug with conventional one- or two-row units (but not windrowed when dug) the vines may be shaken and windrowed with the above equipment or with a side-delivery rake. To avoid possible loss from shedding during the shaking and windrowing operation, the equipment should be operated at a very slow forward speed. Side-delivery rakes may be used for windrowing where such equipment is available, but side raking is not considered to be the desired method, because more soil is left in the peanuts, drying rate of the vines and nuts is retarded, and the windrow is tight, twisted, of small cross section, and more difficult to combine.

## COMBINING PEANUTS FROM THE WINDROW

When freshly dug, Virginia type peanuts contain over 50 percent moisture. After the peanuts are dried in the windrow 4 to 8 days, the moisture seldom drops below 25 to 30 percent as a result of this long field-drying period. Because of the high moisture and slow rate of drying, most windrow combining was delayed from 4 to 8 days after digging. After combining, the peanuts were moved directly into drying bins and further dried until the moisture dropped to approximately 8 to 10 percent. All windrow-harvested peanuts to date have been further dried by artificial means. Since the combine method is wholly dependent on proper drying, considerable time has been devoted to picking peanuts for the curing and drying studies.

Two methods of harvesting, the stack-pole and the windrow, were compared. Comparisons were also made between four different peanut combines.

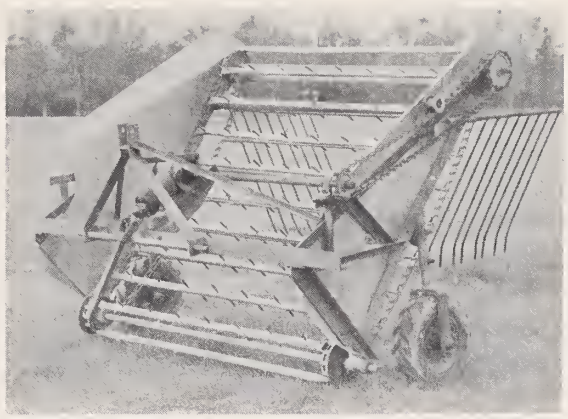

Figure 17. Experimental peanut shaker-windrower with three-point hitch.

Figure 18. Peanut combine of the carding principle with collecting bin for bulk handling.

Figure 19. Peanut combine of the multiple cylinder type with collecting bin for bulk handling.

Combining was confined to picking single windrows made up of two peanut rows. Some of the peanuts were picked green and others were picked from 1 to 10 days after digging. The carding and multiple-cylinder combines were found to be fairly efficient although advantages and disadvantages may be claimed for either type. Figure 18 shows the carding-type combine, and figure 19 shows the multiple-cylinder-type combine.

Features desired in a peanut combine are its ability to pick peanuts resulting in very little foreign material and with a minimum amount of loose shelled, cracked, and broken kernels in the picked sample. It should be capable of picking peanuts from the windrow without undue loss and at a rate equal to that obtained from picking stack-pole peanuts.

Collecting bins for bulk handling offer advantages and are preferred over combines with bagging attachments. An extra man is not needed when bins are used in lieu of bagging attachments. Because of the dusty and dirty conditions encountered when harvesting, it is desirable to keep the man off the harvester and, consequently, out of the dust.

Characteristics of each combine were established through grading several samples of peanuts. The percent loss was determined by picking out the peanuts from the vines, which were caught on a canvas over a predetermined length of windrow.

Early tests made on harvesting windrowed peanuts showed that the percent loss was higher with combines than with stationary pickers and the stack-pole method. Several approaches were made toward reducing the losses. Percent loss was determined while picking under various field conditions shown below.

1. Combining green peanuts and semicured peanuts at different dates after digging.

2. Combine operating at full capacity and approximately one-half capacity.

3. Combining a loose fluffy windrow compared with one that is tight and twisted.

4. Combining peanuts that were clean and free of soil as a result of good windrowing compared with picking peanuts that were poorly dug allowing the nuts to partially remain in the soil.

Green and high-moisture peanuts were more difficult to combine and losses were higher than obtained when combining peanuts with less moisture. Changing the forward speed of the combine within certain limits did not greatly affect the picking efficiency as might be expected. Combining a fluffy windrow improved the picking efficiency slightly over combining a tight and twisted windrow. The peanuts and vines that were shaken after

digging and were reasonably free of soil, combined better and gave cleaner peanuts in the bag. Non-windrowed peanuts were high in moisture content and the hulls were discolored and coated with soil even after picking. The sample, in general, was of poor appearance, dirty, and sandy.

Combine loss from 1952 through 1955 varied from 5.5 percent to approximately 12 percent, with an average of about 9 percent. Combine improvements made at the station in 1956 during harvesting season are believed to have improved the picking efficiency considerably. Tests made toward the end of the 1956 season gave a loss of 3 to 6 percent from picking windrowed or stack-pole peanuts using improved equipment.

Foreign Material: Foreign material consisted mostly of broken peanut vines and stems, pops, and loose shelled kernels. The type of picking in combining affected the percent of foreign material in the picked sample. Soil particles went into the picked peanuts when combining poorly shaked windrows.

Loose Shelled Kernels: The percent of loose shelled kernels will affect quality and grade. According to Research and Marketing Service grading methods and with 1956 prices for each 1 percent loose shelled kernel, the grower loses approximately $1.50 per ton. Both types of commercially produced peanut combines are shelling a higher percentage of peanuts than are shelled with the better type stationary machine picking stack pole peanuts.

Capacity: Damp peanut vines are tough and impose greater stress on picking machanisms. Therefore, more power is required to operate a combine than is needed to operate a stationary picker. Prior to 1956 commercially-produced combines were operated at a very slow forward speed to avoid choking the machinery and stalling the engine. Optimum traveling speed in 1955 was approximately 100 feet per minute. Two makes of combines were equipped with larger engines for the 1956 season and each performed better and at a more moderate forward speed, or approximately 130 to 150 feet per minute. Under normal operating conditions a peanut combine may cover 4 to 6 acres or pick 100 to 150 bags per day.

Salvaging Peanut Vines: Peanut vines that have been combined may be salvaged for livestock feed or bedding. Vines from 6 peanut rows (3 windrows) were side-raked into a large windrow and baled with an automatic hay baler. Peanut vines that were dry when baled (6 to 12 hours after combining) did not require additional drying and did not heat when stored.

## CONCLUSIONS

Production model peanut combines picking from the windrow shelled a higher percentage and left more foreign material in the picked sample, and had lower picking capacity than stationary pickers picking from the stack

pole. Mid-season changes have improved combine picking efficiency and reduced some of the shelling. Installation of larger engines have improved machine capacity.

Proper formation of the windrow, loose, fluffy, of uniform moisture, and free of soil particles, aided the combining operation and gave a clean and good quality peanut. Proper digging of the peanuts with efficient diggers and shaking when needed after digging tends to insure good windrows.

A summary of the many factors found to contribute to combine efficiency as related to losses, capacity, loose shelled kernels, and foreign material is as follows:

1. General condition of peanuts and vines at harvesttime depending upon:
    a. Moisture of the vines and nuts.
    b. Type of windrow, whether tight or loose.
    c. Amount of foreign material; particularly, dirt, weeds, and grasses.
    d. Degree of brittleness of the vines.
    e. Quality of the peanuts.
2. Speed or rate of combining the windrow.
3. Method of feeding, whether uniform or intermittent.
4. Speed of the picker mechanisms.
5. Adjustments of the picking separation and cleaning units.
6. Type of picking principle employed.
7. Type of machine as relates to make and model.

## RECOMMENDATIONS

Digging and Shaking: In the initial digging operations and subsequent shaking and windrowing operations, leave the windrow fluffy, untangled, free of soil, and with the maximum quantity of nuts up and off the ground. Shaking and windrowing is desired after digging and should be done 1 to 3 days after digging and when the ground is dry and dusty. Shake and windrow after rains if needed and deemed advisable. A combination digger-shaker-windrower followed later by a shaker is preferred

over standard diggers and side-rakes. To avoid possible loss of peanuts by the shaker-windrower, travel at a very slow forward speed and operate the conveyor chain at a slow speed. After digging avoid running over peanuts with the tractor, digger, or combine wheels.

Combining from the Windrow: Delay combining until 4 to 8 days after digging. If losses exceed 6 percent, inspect combine units and clean out picking and separating screens and racks, if needed; consider slowing down forward speed of combine. Minimize shelling damage by selective adjustment of speeds, clearances, and rates of feeding. Reduce percent of foreign material by adjustment of air baffles. Where practicable, delay combining until after the excess moisture from dew or rain has dried off. After combining, the peanuts must be cured as explained by N. C. Teter and R. L. Givens (14).

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